AMENDMENTS TO THE CLAIMS

The claims in this listing will replace all prior versions, and listings, of claims in the application.

1. (Currently Amended) A signal processing method for use in an adaptive array antenna system of a CDMA (Code Division Multiple Access) mobile communications network, the method comprising~~ the steps of~~:

~~(a)~~ initializing a weight vector and a snapshot index;

~~(b)~~ obtaining a gradient of output power of an array antenna to a phase of each ~~of antennas~~ antenna in the array antenna system at every snapshot and determining whether an adaptive gain is added or subtracted depending on the signature of the gradient to update the phase of each antenna; and

~~(c)~~ determining a weight value for each of the antennas depending on the result of ~~the step (b)~~ obtaining the gradient of output power and determining whether the adaptive gain is added or substracted at every snapshot to apply the weight value to a signal received at the corresponding one of the antennas.

2. (Currently Amended) The method as recited in claim 1, wherein the ~~step of (b)~~ obtaining the gradient of the output power and determining whether the adaptive gain is added or substracted includes~~ the steps of~~:

~~(d)~~ when a signal is received, computing an output signal $\underline{y}$ based on an equation~~ as~~:

$$y = \underline{w}^H \cdot \underline{x},$$

wherein y is the output signal of the array antenna, w^H is a complex weight vector and x is a signal received at an antenna;

~~(e)~~ computing the gradient of the output power to the phase of each of the antennas based on an equation~~as~~:

$$\nabla_m P = \frac{\partial P}{\partial w_m^*} \frac{\partial w_m^*}{\partial \phi_m} = -jx_m w_m^* y^*,$$

wherein $\nabla_m P$ is the gradient of the output power of the m-th antenna, ϕ_m is phase delay to be applied to the m-th antenna, x_m is a signal received at an m-th antenna, w_m is a complex weight vector applied to the signal received at the m-th antenna, w_m^* is a conjugate of w_m, and y is an output of the array antenna;

~~(f)~~ determining whether ~~an~~ the adaptive gain is added to a phase delay vector value or subtracted from the phase delay vector depending on the signature of the gradient to update the phase delay vector based on an equation ~~as~~:

$$\underline{\Phi}_{n+1} = \underline{\Phi}_n + \mu \cdot sign(\underline{\nabla}P),$$

wherein Φ is the phase delay vector, μ is the adaptive gain, ∇P is the gradient of the output power and a signum function $sign$ outputs the signature of ∇P.

3. (Currently Amended) The method as recited in claim 2, wherein ~~the step of (c)~~ determining a weight value includes ~~the step of (g)~~ updating the weight vector by using the updated phase delay vector based on an equation ~~as~~:

$$\underline{w}_{n+1} = e^{j\underline{\Phi}_{n+1}},$$

wherein $\underline{\Phi}$ is the phase delay vector.

4. (Currently Amended) The method as recited in claim 3, further comprising ~~the steps of~~:

~~(h)~~ repeating ~~the steps of (d) to (g)~~ computing the output signal, computing the gradient of the output power, determining whether the adaptive gain is added or subtracted and updating the weight vector, after a next signal is received to perform signal processing ~~over~~ of the signal at every snapshot.

5. (Original) The method as recited in claim 4, wherein the adaptive array antenna system is a one-dimensional array antenna system.

6. (Original) The method as recited in claim 4, wherein the adaptive array antenna system is a two-dimensional array antenna system.

7. (Currently Amended) The method as recited in claim 5, wherein ~~the~~ a total number of computations is ~~totally~~ of the order of 4N including computation of the order of N for computing the output signal, computation of the order of 2N for computing the gradient of the output power and computation of the order of N for computing the phase delay vector, when the number of antennas is N, and wherein N is a natural number.

8. (Currently Amended) The method as recited in claim 6, wherein ~~the~~ a total number of computations is ~~totally~~ of the order of $4N^2$ including computation of the order of N^2 for computing the output signal, computation of the order of $2N^2$ for computing the gradient of the output power and computation of the order of N^2 for computing the phase delay vector, when the number of antennas is N, and wherein N is a natural number.

9. (Currently Amended) A computer-readable recording medium ~~for~~ storing a program which implements a method for ~~implementing, in a CDMA adaptive array antenna having a processor, to~~ maximizing transceiving gain only in a direction toward a target mobile station during ~~transceivng~~ transceiving a signal between a base station and the mobile station, in a CDMA adaptive array antenna system having a processor, the ~~functions of~~ method comprising:

~~(a)~~ initializing a weight vector and a snapshot index;

~~(b)~~ obtaining a gradient of output power of an array antenna to a phase of each of a plurality of antennas in the array antenna system at every snapshot and determining whether an adaptive gain is added or subtracted depending on ~~the~~ a signature of the gradient to update the phase of each antenna; and

~~(c)~~ determining a weight value for each of the antennas depending on ~~the~~ a result of ~~the step (b)~~ obtaining the gradient of the output power and determining whether the adaptive gain is added or subtracted, at every snapshot to apply the weight value to a signal received at ~~the~~ a corresponding one of the antennas.

10. (Currently Amended) A computer readable recording medium ~~for~~ storing a program which implements a method for ~~implementing, in a CDMA adaptive array antenna system having a processor, to~~ maximizing ~~transceivng~~ transceiving gain only in a direction to a target mobile station during transceivng a signal between a base station and [[a]] the mobile station, in a CDMA adaptive array antenna system having a processor, the ~~functions of~~ method comprising:

~~(a)~~ initializing a weight vector and a snapshot index;

~~(b)~~ when a signal is received, computing an output signal based on an equation ~~as~~:

$$y = \underline{w}^H \cdot \underline{x},$$

wherein y is the output signal of the array antenna, $\underline{w}^H$ is a complex weight vector and $\underline{x}$ is a signal received at an antenna;

~~(c)~~ computing ~~the~~ a gradient of ~~the~~ an output power to ~~the~~ a phase of each of the antennas based on an equation ~~as~~:

$$\nabla_m P = \frac{\partial P}{\partial w_m^*} \frac{\partial w_m^*}{\partial \phi_m} = -jx_m w_m^* y^*,$$

wherein $\nabla_m P$ is the gradient of the output power of the m-th antenna, ϕ_m is phase delay to be applied to the m-th antenna, the phase delay vector, x_m is a signal received at an m-th antenna, w_m is a complex weight vector applied to the arrived signal at the m-th antenna, w_m^* is a conjugate of w_m, and y is an output of the array antenna;

~~(d)~~ determining whether an adaptive gain is added to a phase delay vector value or subtracted from the phase delay vector value depending on ~~the~~ a signature of the gradient to update ~~the~~ a phase delay vector based on an equation~~as~~:

$$\underline{\Phi}_{n+1} = \underline{\Phi}_n + \mu \cdot sign(\underline{\nabla P}),$$

wherein $\underline{\Phi}$ is the phase delay vector, μ is the adaptive gain, $\underline{\nabla P}$ is the gradient of the output power and a signum function $sign$ outputs the signature of $\underline{\nabla P}$;

~~(e)~~ updating the weight vector by using the updated phase delay vector based on an equation~~as~~:

$$\underline{w}_{n+1} = e^{j\underline{\Phi}_{n+1}},$$

wherein $\underline{\Phi}$ is the phase delay vector; and

~~(f)~~ repeating ~~the steps of (d) to (g)~~ computing the output signal, computing the gradient of the output power, determining whether the adaptive gain is added or subtracted, and updating the weight vector, after a next signal received to perform signal processing ~~over~~ of the signal at every snapshot.